



Arsenic in Drinking Water

Arsenic is the twentieth most abundant element in the earth's crust and frequently occurs in rock formations of the Southwestern United States (including Arizona). If aquifers are in contact with rocks and minerals containing arsenic, then water pumped from these sources may contain detectable amounts of arsenic. Arsenic remains in the environment over long periods and when it occurs in high concentrations, can be toxic to many life forms. Interestingly enough, arsenic has been shown to be an essential nutrient for many animal species and may be essential to humans (in very small amounts) as well.

Inorganic Arsenic

Under natural conditions, arsenic usually occurs at low levels and is chemically bonded with other elements such as oxygen, chlorine, and sulfur. These are called inorganic arsenic compounds. Inorganic arsenic is the form that can occur in domestic water supplies.

Organic Arsenic

Arsenic found in plants and animals is chemically bonded with carbon and hydrogen. This is called organic arsenic and is usually less harmful to other life forms than inorganic arsenic.

Water Testing

Municipal water suppliers should have their water tested regularly and the resulting mineral content data available to the public upon request. Arsenic concentrations in water supplies can vary tremendously from location to location. Neighboring wells can have markedly different arsenic concentrations. If you obtain domestic water from a well or other untested source, water samples can be collected and analyzed for arsenic content by an environmental testing laboratory for \$30 to \$40. To find out where to have your water tested, see the University of Arizona Cooperative Extension publication called *Laboratories Conducting Soil, Plant, Feed, or Water Testing*. It is available on-line at cals.arizona.edu/pubs/ or in county Cooperative Extension offices.

Current Standards

Based on scientific research evidence, the Environmental Protection Agency (EPA) has lowered the Maximum Contaminant Level (MCL) for inorganic arsenic in drinking water from 50 ppb to 10 ppb (ppb = parts per billion or micrograms per liter). The new standard of 10 ppb takes effect on January 23, 2006 and applies to all community water systems. A community water system is a system that serves 15 locations or 25 residents year-round, including most cities and towns, apartments, and mobile home parks with their own water supplies. Many of Arizona's community water systems have made modifications in their treatment systems to meet the new arsenic standard.

Human Health

In most cases, the human body can tolerate infrequent ingestion of small amounts of inorganic arsenic (below the MCL). Here, the arsenic would be converted to the organic form and excreted in the urine. Research has shown arsenic's effects on human health to be variable depending on sex, ethnicity, concentration, and length of exposure. Arsenic poisoning may be acute or chronic. Acute poisoning occurs when high levels (over 60 mg/L) of arsenic are ingested over short periods of time. This is more likely to occur in settings where arsenic has been concentrated by industrial processes or at waste sites. Chronic poisoning occurs when moderate or small amounts of arsenic are ingested over long periods. Chronic poisoning could potentially

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occur where groundwater containing inorganic arsenic in excess of the MCL is consumed daily for extended periods. Low levels of exposure may cause the following symptoms: gastrointestinal irritation, decreased production of red and white blood cells, abnormal heart rhythm, blood vessel damage, and “pins and needles” sensation in hands and feet. Long term exposure may lead to changes in fingernails and toenails, darkening and/or thickening of the skin and the appearance of small corns or warts on the palms, soles and torso. Arsenic is a known carcinogen and long term ingestion may increase the risk of skin cancer and tumors of the bladder, liver, kidney, and lungs. Direct skin contact may cause redness and swelling at high concentrations.

Human Testing

There are tests available that can measure exposure to high levels of arsenic. Urine is the most reliable test for arsenic exposure. However, arsenic stays within the body only a short time and urine testing must be done directly following exposure. Analysis of hair and fingernails can also measure exposure to high levels of arsenic over the past 6-12 months. These tests can only measure high level exposure and will not predict the likelihood of harmful health effects. Persons exhibiting the previously mentioned symptoms or who are concerned about arsenic exposure, should seek the advice of a medical doctor.

Plant Tolerance

Plants vary widely regarding their tolerance to arsenic. For example, sudan grass can grow in arsenic concentrations as high as 12 ppm while rice can tolerate only 0.05 ppm. Little is known about arsenic poisoning risk associated with crops grown in areas of elevated arsenic concentrations (soil or water).

It is known that arsenic can accumulate in plant root systems. Certain plants may grow normally while accumulating toxic levels of arsenic in the roots. Gardeners may choose to avoid growing root crops such as carrots, beets, potatoes or onions if the area is suspected of containing high levels of arsenic. Furthermore, gardeners wishing to avoid arsenic ingestion altogether should grow flowers and non-edible plants.

Removing Arsenic from Water

Many water treatment devices are effective at removing arsenic. Water softeners, activated carbon filters, or UV treat-

ment do not remove arsenic, nor will boiling your water. Two water treatment processes/systems are readily available to consumers for arsenic removal. These are reverse osmosis and distillation. Of the two processes, reverse osmosis devices are less costly, take less time, and use less energy than distillation devices. Many water treatment companies sell or rent reverse osmosis devices and offer maintenance agreements. However, most home reverse osmosis systems cannot reduce arsenic levels by more than 15%. Consumers should check with the reverse osmosis manufacturer as its ability to reduce arsenic levels prior to purchasing one for that purpose. The most reliable water treatment process for arsenic removal is distillation. However, the process is not considered as financially practical due to the energy and equipment required.

Research and development of new technology for point-of-use treatment systems designed specifically for private well owners is currently underway. Such point-of-use systems will incorporate both reverse osmosis technologies and the use of integrated arsenic-specific filter(s). These systems are more expensive than stand-alone reverse osmosis systems and would require a more intensive maintenance/filter replacement regime. Actual costs to install, operate, monitor and maintain these systems are dependent upon the level of arsenic contamination, individual well water chemistry, and the amount of water to be treated/used by the consumer.

Cooperative Extension is not responsible for plant or human health problems associated with high arsenic levels in plants, soil or water.

For Further Information Contact:

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